

[Evaluation Standard]

(Releasing Property)

- A: No problem occurs throughout the whole evaluation temperature range.
- B: Slight tendency of twisting is found depending on the temperature, but there is
- 5 substantially no problem.
- C: A temperature where releasing cannot be conducted is present.

(Uniformity of Solid Image)

- A: Completely no image unevenness is found.
- B: Slight image unevenness is found, but there is no practical problem.
- 10 C: Some image unevenness is found but is in the allowable level.
- D: Considerable image unevenness is found and is not allowable.

In the invention employing the constitution described in the foregoing, the followings are realized even when the oilless fixing process is employed. Both the fixing releasing property and the transferring and developing properties can be

15 achieved; the lowest fixing temperature can be decreased; the high temperature offset can be prevented; and good image preservation property can be obtained, whereby an image of good quality can be provided.

The entire disclosure of Japanese Patent Application No. 2000-268679 filed on September 5, 2000 including specification, claims and abstract is incorporated

20 herein by reference in its entirety.

WHAT IS CLAIMED IS:

1. A toner for developing an electrostatic image comprising a resin, a colorant and a releasing agent, wherein the toner has protrusions having a height of approximately $0.05\text{ }\mu\text{m}$ to $2\text{ }\mu\text{m}$ on the surface thereof, a part of the protrusions contain
5 the releasing agent inside thereof, and the toner is characterized by a ratio of an element derived from the releasing agent to the elements on the surface of the toner determined by X-ray photoelectron spectroscopy, the element ratio being smaller than 10 % by atom.

10 2. The toner for developing an electrostatic image as claimed in claim 1, wherein the protrusions have a height of approximately from 0.1 to $1\text{ }\mu\text{m}$.

15 3. The toner for developing an electrostatic image as claimed in claim 1, wherein at least the part of the protrusions containing the releasing agent inside are formed by migration of the releasing agent.

4. The toner for developing an electrostatic image as claimed in claim 1, wherein the releasing agent in the protrusions has an acicular form.

20 5. The toner for developing an electrostatic image as claimed in claim 1, wherein the toner particles have a surface property index of approximately 2.0 or less which is measured under the condition of the toner without external additive, the surface property index being defined by the following equations:

(Surface property index) =

(Measured specific surface area)/(Calculated specific surface area)

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Sub
B3

Sub
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A

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PA
(Calculated specific surface area) =

$$6\Sigma(n \times R^2)/(\rho \times \Sigma(n \times R^3))$$

wherein n represents a number of particles in a channel of a Coulter Counter, R represents a channel particle diameter in the Coulter Counter, and ρ represents a toner density.

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6. The toner for developing an electrostatic image as claimed in claim 5, wherein the surface property index is in the range of about from 1.0 to 1.8.

10 7. The toner for developing an electrostatic image as claimed in claim 1, wherein the toner has an external additive added to a surface of the toner particles, and the external additive has an average primary particle diameter of about 0.2 μm or less, and the external additive is added in an amount of about from 1 to 3 parts by weight per 100 parts by weight of the toner.

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8. The toner for developing an electrostatic image as claimed in claim 1, wherein the toner has a volume average particle diameter (D_{50}) of about from 2 to 10 μm .

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9. The toner for developing an electrostatic image as claimed in claim 1, wherein the toner has a shape factor SF1 of about from 100 to 140, the SF1 being defined by the following equation:

$$\text{SF1} = (\text{ML}^2/\text{A}) \times (\pi/4) \times 100$$

wherein ML represents a maximum length of the toner particles, and A represents a projected area of the toner particles.

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10. The toner for developing an electrostatic image as claimed in claim 1, wherein the toner has a volume average particle size distribution index GSDv of about 1.25 or less, the GSDv being defined by the following equation:

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$$\text{GSDv} = (D_{84v}/D_{16v})^{0.5}$$

wherein D_{84v} represents a diameter (μm) at which the volume accumulated particle distribution becomes 84%, and D_{16v} represents a diameter (μm) at which the volume accumulated particle distribution becomes 16%.

10 ~~11. The toner for developing an electrostatic image as claimed in claim 1, wherein the releasing agent is selected from the group of polyethylene wax, paraffin wax, Fischer-Tropsch wax and nitrogen containing wax.~~

15 12. A developer for developing an electrostatic image, the developer comprising a toner and a carrier, wherein the toner has protrusions having a height of approximately $0.05 \mu\text{m}$ to $2 \mu\text{m}$ on the surface thereof, a part of the protrusions contain a releasing agent inside thereof, and a ratio of an element derived from the releasing agent to the elements on the surface of the toner determined by X-ray photoelectron spectroscopy, the element ratio being smaller than 10 % by atom.

20 13. The developer as claimed in claim 12, wherein the toner particles have a surface property index of approximately 2.0 or less which is measured under the condition of the toner without external additive.

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14. The developer as claimed in claim 12, wherein the toner has a volume average particle size distribution index GSDv of about 1.25 or less.

15. A process for producing the toner for developing an electrostatic
5 image claimed in claim 1, the process comprising:

mixing at least a resin particle dispersion and a releasing agent dispersion to prepare an aggregated particle dispersion;

heating the aggregated particle dispersion to form the toner particles; and

10 forming protrusions on a surface of the toner by migration of the releasing agent.

16. The process as claimed in claim 15, wherein the step of heating the aggregated particles dispersion comprises an intermediate step of heating at a temperature in a range of $\pm 20^{\circ}\text{C}$ from the melting point of the releasing agent, for 2 to
15 10 hours.

17. A process for forming an image, comprising:

forming an electrostatic latent image on an electrostatic image holding member;

20 developing the electrostatic latent image with the developer as claimed in claim 12 on a developer holding member to form a toner image;

transferring the toner image to a transfer material; and

fixing the toner image on the transfer material.

25 18. The process as claimed in claim 17, further comprising:

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recovering the toner remaining on the electrostatic image holding member and reusing the toner in the developing step.

19. The process as claimed in claim 17, wherein the transferring step
5 comprises a step of transferring the toner image to an intermediate transfer material, and a step of transferring the toner image to a final transfer material.

20. The process as claimed in claim 17, wherein the fixing step employs an oilless fixing process.

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